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ABSTRACT

This document, which reflects Mississippi's statutory requirement that instructional programs be based on core curricula and performance-based assessment, contains outlines of the instructional units required in local instructional management plans and daily lesson plans for secondary-level courses to prepare Mississippi vocational students for the programs of electrician I and II. Presented first are a program description and outlines for the five units for the program of electrician I: orientation, safety, leadership/personal development, and direct current and alternating current circuits. The 13 units for the program of electrician II are as follows: orientation, safety review, advanced leadership, tools/equipment and materials/supplies, alternating current circuits and residential wiring, blueprints and calculations, load centers and overcurrent protection, rough-in, residential service, trim-out and troubleshooting, motors and controllers, programmable logic controllers, and employability skills. Section I contains curriculum frameworks for both programs and section II contains outlines of the instructional units required in each program. Each unit includes suggested time on tasks, competencies and objectives, teaching strategies, assessment strategies, and resources. Recommended tools and equipment are listed in section III. Appended are lists of related academic topics and workplace skills for the 21st century and student competency profiles for the occupations of electrician I and electrician II. (MN)

ED 397 309

Mississippi Curriculum Framework for

Electrician

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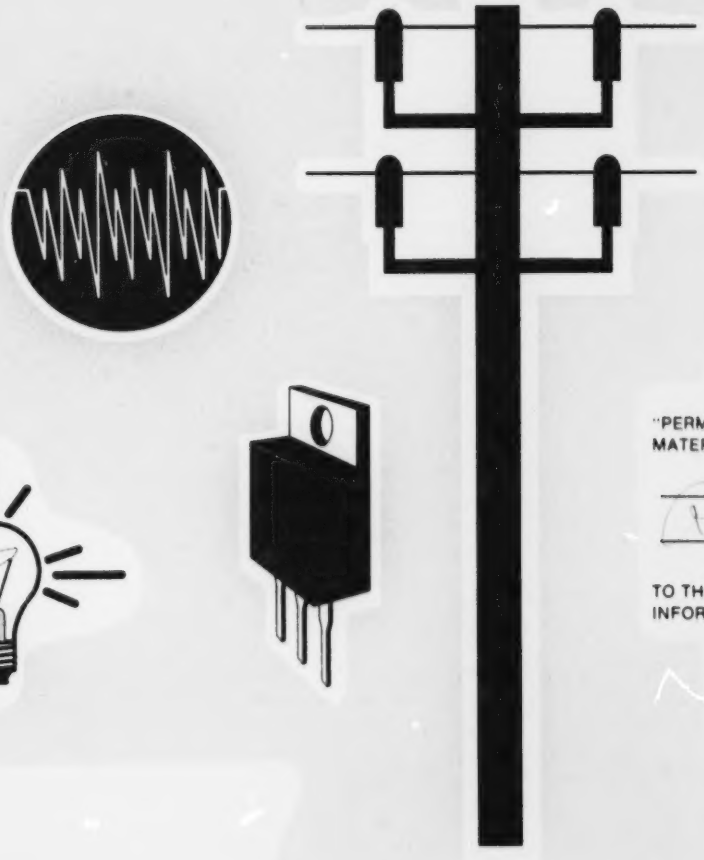

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Secondary Vocational-Technical Education 1995

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August 1, 1995

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CURRICULUM FRAMEWORK

FOR

ELECTRICIAN

(PROGRAM CIP: 46.0302 - ELECTRICIAN)

SECONDARY PROGRAMS 1995

August 1, 1995

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FOREWORD

The courses in this document reflect the following statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended:

> The State Department of Education shall provide an instructional program and establish guidelines and procedures for managing such programs in the public schools as part of the State Program of Educational Accountability and Assessment of Performance. . .
>
> The department shall provide that such program or guidelines . . . are enforced through the performance-based accreditation system.
>
> The local school board must adopt the objectives that will form the core curriculum that will be systematically delivered throughout the district.
>
> Standards for student performance must be established for each core objective in the local program and those standards establish the district's definition of mastery for each objective.
>
> There shall be an annual review of student performance in the instructional program against locally established standards.

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - The number of days of instruction that should be required to teach the competencies and objectives of the unit. For secondary occupational programs, a "day" represents a two-period block of instruction.
- Competencies and Suggested Objectives
  - A **Competency** represents a general concept of performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies in the curriculum framework.
  - The **Suggested Objectives** represent the enabling and supporting knowledge and performances that will indicate mastery of the competency.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each suggested objective. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include classroom discussions, laboratory exercises, and student assignments. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Suggested Resources - This section indicates some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

The following guidelines were used in developing the curriculum framework in this document and should be considered in developing local instructional management plans and daily lesson plans:

- The content of the courses in this document reflects approximately 75 percent of the time allocated to each course. For a one-year course, this means that the content of the existing units of instruction should represent approximately 135 days of instruction. The remaining 25 percent of each course should be developed at the local district level and may reflect:
  - Additional units of instruction within the course related to topics not found in the state framework.
  - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised.
  - Activities which implement components of the Mississippi Tech Prep Initiative, including integration of academic and vocational-technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational-technical programs.
  - Individualized learning activities, including work site learning activities, to better prepare individuals in the courses for their chosen occupational area.

- Sequencing of the units of instruction within a course is left to the discretion of the local district. Naturally, foundation units related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other units related to specific skill areas in the course, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

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TABLE OF CONTENTS

Page

FOREWORD iii

ACKNOWLEDGEMENTS vii

PROGRAM DESCRIPTION 1

COURSE OUTLINE 2

SECTION I: CURRICULUM FRAMEWORK FOR ELECTRICIAN 3

Electrician I 5
Electrician II 11

SECTION II: CURRICULUM GUIDE FOR ELECTRICIAN 21

Electrician I 23
Unit 1: Orientation 25
Unit 2: Safety 27
Unit 3: Leadership and Personal Development 30
Unit 4: Direct Current (DC) Circuits 33
Unit 5: Alternating Current (AC) Circuits 37

Electrician II 43
Unit 1: Orientation 45
Unit 2: Safety (Review) 47
Unit 3: Advanced Leadership 50
Unit 4: Tools, Equipment, and Materials/Supplies 51
Unit 5: AC Circuits for Residential Wiring 54
Unit 6: Blueprints and Calculations 56
Unit 7: Load Centers and Overcurrent Protection 58
Unit 8: Rough-In 60
Unit 9: Residential Service 62
Unit 10: Trim-out and Troubleshooting 64
Unit 11: Motors and Controllers 66
Unit 12: Programmable Logic Controllers (PLC) 70
Unit 13: Employability Skills 72

SECTION III: RECOMMENDED TOOLS AND EQUIPMENT 73

APPENDIX A: RELATED ACADEMIC TOPICS A-1

APPENDIX B: WORKPLACE SKILLS B-1

APPENDIX C: STUDENT COMPETENCY PROFILES C-1

Electrician I C-3
Electrician II C-5

PROGRAM DESCRIPTION

ELECTRICIAN

(Program CIP: 46.0302 - Electrician)

Electrician is an instructional program which prepares secondary students to enter residential electricity occupations. Students in Electrician I complete a common core program of study including safety, leadership and personal development, and basic alternating and direct current (AC/DC) theory. Students in Electrician II continue study in safety; advanced leadership; tools, equipment, and materials/supplies; alternating current (AC) circuits for residential wiring; blueprints and calculations; load centers and overcurrent protection; rough-in; residential service; trim-out and troubleshooting; motors; controllers; programmable logic controllers (PLC); and employability skills. Upon completion of study, graduates may elect to continue their education or become employed in the electrical trades industry as a helper or apprentice.

COURSE OUTLINE

ELECTRICIAN I

Unit #	Title	Days
Unit 1	Orientation	5
Unit 2	Safety	10
Unit 3	Leadership and Personal Development	5
Unit 4	Direct Current (DC) Circuits	50
Unit 5	Alternating Current (AC) Circuits	65

ELECTRICIAN II

Unit 1	Orientation	1
Unit 2	Safety (Review)	4
Unit 3	Advanced Leadership	5
Unit 4	Tools, Equipment, and Materials/Supplies	10
Unit 5	AC Circuits for Residential Wiring	25
Unit 6	Blueprints and Calculations	10
Unit 7	Load Centers and Overcurrent Protection	5
Unit 8	Rough-in	10
Unit 9	Residential Service	5
Unit 10	Trim-out and Troubleshooting	15
Unit 11	Motors and Controllers	20
Unit 12	Programmable Logic Controllers (PLC)	20
Unit 13	Employability Skills	5

SECTION I:

CURRICULUM FRAMEWORK

FOR

ELECTRICIAN

CURRICULUM FRAMEWORK

Course Name: Electrician I

Course CIP Code: 46.0302

Course Description: Electrician I is the entry level course of the secondary Electrician program. Students in this course will gain foundation competencies related to orientation, safety, leadership and personal development, direct current circuits, and alternating current circuits. (2-2½ Carnegie units, depending upon time spent in the course)

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
   a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations..

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
2. Describe employment opportunities and responsibilities for electronics technicians and related employees.
   a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
3. Describe personal and general safety rules for working in a shop/lab and industry.
   a. Describe personal safety rules for working in a shop/lab and industry including work clothing, protective clothing, safety glasses, and hearing, feet, hand, and head protection.
   b. Describe general workplace safety rules including shop/lab (work site) organization.

c. Describe the proper use of fire extinguishers and classes of fires including class A (trash and wood), B (petroleum products), C (energized electrical), and D (combustible metals).
d. Identify standard industry Safety Color Codes.
e. Describe procedures for safely handling heavy objects including using lifting devices, having straight back, lifting with legs, getting help for heavy objects, holding objects close to the body, sizing up load, and holding feet close together.
f. Describe safety practices for using climbing devices including ladders, scaffolding, and climbing belts.
g. Describe the Occupational Safety and Health Act (OSHA) and its effect on the workplace.

Related Academic Topics (See Appendix A):

C2, C4

Workplace Skills (See Appendix B):

WP5

4. Describe basic electrical safety practices.
   a. Describe factors to consider in storing and/or disposing of hazardous materials including PCB's in old transformers and capacitors, volatile liquids, battery acid, explosive gases, refrigerants, and POL products.
   b. Identify hazardous materials that may be found on a job site and describe procedures for handling/avoidance or removal of materials including asbestos, PCB's, POL products, refrigerants, flammable materials, and smoke.
   c. Interpret a Materials Safety Data Sheet (MSDS).
   d. Describe basic electrical safety practices including removal of jewelry and metal objects from body, probing techniques, using insulated gloves and boots, grounding, and personal safety devices.
   e. Describe hazards of electrical shock including effects of current, shock avoidance techniques, and shock treatment procedures.
   f. Describe accident procedures including getting help, basic first aid, cardiopulmonary resuscitation (CPR), and accident report form.
   g. Describe basic electric circuit safety methods including proper grounding, importance of third wire, and ground fault interrupters.
   h. Describe the operation of current overload devices including fuses and circuit breakers.

   Related Academic Topics (See Appendix A):

   C1, C4, C5

   S5, S6, S8

   Workplace Skills (See Appendix B):

   WP5, WP6

5. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electronics by the Vocational Industrial Clubs of America (VICA).

a. State procedures of leadership used in organizational meetings to reach an agreement in an orderly manner including procedures for gaining recognition in a meeting and conducting a VICA Club meeting.
b. Describe the purposes of VICA including leadership development, personal development, and skills competition.

Related Academic Topics (See Appendix A):
C5, C6

Workplace Skills (See Appendix B):
WP1, WP3, WP6

6. Identify desirable personal behavior and characteristics for use in the electronic occupations.
   a. Identify desirable personality traits to apply when serving the public including politeness, cheerfulness, enthusiasm, efficiency, competency, friendliness, self-confidence, honesty, and integrity.
   b. Identify desirable personality traits to apply when communicating with employees, supervisors, and other employees including effective communication skills, positive attitude, honesty, integrity, loyalty, team commitment, cooperation, and ability to follow oral and written instructions.
   c. Identify desirable characteristics of the personal work ethic to apply in electronics including attendance, promptness, desire to achieve, loyalty, competent performance as required by employer, effective customer relations, cooperation, and obedience to rules and regulations.

   Related Academic Topics (See Appendix A):
   C4, C5, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6

7. Identify legal requirement for participation in electronics occupations.
   a. Describe ways to avoid legal liability problems in electronics including using equipment approved by national testing organization; installing wiring to NEC, local codes, and customer specifications; and maintaining license and bonding.

   Related Academic Topics (See Appendix A):
   C3, C4, C6

   Workplace Skills (See Appendix B):
   WP4, WP6

8. Describe the terms and scientific principles associated with direct current electricity.
   a. Define terms associated with the nature of matter including physical characteristics of matter (elements, compounds, atoms, electrons, protons, and neutrons).
   b. Describe laws of electrical charges including like and unlike charges.
   c. Identify electrical materials including conductors, insulators, and semiconductors.

d. Describe methods of generating electricity including solar, chemical, mechanical, and thermal.
e. Describe the principles and operation of batteries.
f. Describe basic theories of current flow including electron and conventional flow methods.
g. Describe DC circuit parameters including voltage, power, current, and resistance.
h. Identify resistor types and values using standard resistor color codes and alphanumeric codes.
i. Perform basic engineering notation calculations including conversion, adding, subtracting, multiplying, and dividing.
j. Identify DC circuit schematic symbols.

Related Academic Topics (See Appendix A):

C1, C5, C6
M1, M4
S6, S8

Workplace Skills (See Appendix B):

WP1, WP2, WP4, WP6

9. Create circuits and measure DC electricity using the multimeter.
   a. Describe and demonstrate use of a multimeter including measuring voltage, current, and resistance.
   b. Demonstrate use of Ohm's Law to calculate circuit parameters for a series circuit including voltage, current, resistance, and power.
   c. Draw and construct a series circuit with a minimum of three resistances.
   d. Calculate and measure circuit parameters for a series circuit.
   e. Demonstrate use of Ohm's Law to calculate circuit parameters for a parallel circuit including voltage, current, resistance, and power.
   f. Draw and construct a parallel circuit with a minimum of three resistances.
   g. Calculate and measure circuit parameters for a parallel circuit.
   h. Demonstrate use of Ohm's Law to calculate circuit parameters for a series-parallel circuit including voltage, current, resistance, and power.
   i. Draw and construct a series-parallel circuit with a minimum of three resistances.
   j. Calculate and measure circuit parameters for a series-parallel circuit.

   Related Academic Topics (See Appendix A):

   C1, C4, C6
   M1, M4
   S6, S8

   Workplace Skills (See Appendix B):

   WP4, WP5, WP6

10. Describe the principles of magnetism and electromagnetic properties.
    a. Describe the principles of magnetism including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.

b. Describe the principles of electromagnetic properties including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.
c. Construct a simple electromagnet, including use of copper windings and a metal rod.

Related Academic Topics (See Appendix A):

C1, C2, C4, C5
M1, M4
S6, S8

Workplace Skills (See Appendix B):

WP4, WP5, WP6

11. Describe the terms and scientific principles associated with alternating current electricity.
    a. Describe principles of AC generation including sine wave characteristics and magnetic induction.
    b. Define terms associated with AC voltage including AC frequency, period, and time.
    c. Describe sources of AC voltage including power plants (hydroelectric, fossil fuel, solar, wind, and nuclear power) and generators.
    d. Describe distribution route and components used from power plant to home or business including transmission lines, transformers, substations, and service entrances.
    e. Describe the properties and characteristics of inductors including inductance, physical properties, DC and AC characteristics, units, current, and frequency.
    f. Describe the properties and characteristics of transformers including rating, types, uses, turns ratio, and connections.
    g. Describe properties and characteristics of capacitors including capacitance, physical properties, DC and AC characteristics, units, and reactance.
    h. Describe differences in phases in electrical power supply, including single-phase, and polyphase.

    Related Academic Topics (See Appendix A):

    C1, C2, C4, C5
    M1, M2
    S5, S8

    Workplace Skills (See Appendix B):

    WP2, WP5, WP6

12. Display and measure AC waveforms using the oscilloscope and function generator.
    a. Demonstrate the use of an oscilloscope including safety and measurement of DC and AC voltages and time.
    b. Demonstrate the use of a function generator including safety, square wave, sine wave, sawtooth wave, frequency, and amplitude.

Related Academic Topics (See Appendix A):

C2, C4, C5
M2, M4
S5, S8

Workplace Skills (See Appendix B):

WP1, WP4, WP5

13. Describe and construct series and parallel circuits.
    a. Draw and construct a series resistive circuit, calculating parameters and discussing phase relationship.
    b. Draw and construct a parallel resistive circuit, calculating parameters and discussing phase relationship.
    c. Draw and construct a series inductive circuit including calculating parameters and time and voltage measurement in a circuit with two inductors.
    d. Draw and construct a parallel inductive circuit including calculating parameters and time and voltage measurement in a circuit with two inductors.
    e. Draw and construct a series RL circuit including calculating parameters and time and voltage measurement.
    f. Draw and construct a parallel RL circuit including calculating parameters and time and voltage measurement.
    g. Draw and construct a series capacitive circuit including calculating parameters and time and voltage measurement of a circuit with two capacitors.
    h. Draw and construct a parallel capacitive circuit including calculating parameters and time and voltage measurement of a circuit with two capacitors.
    i. Draw and construct a series RC circuit including calculating parameters and time and voltage measurement.
    j. Draw and construct a parallel RC circuit including calculating parameters and time and voltage measurement.
    k. Draw RL and RC time constants including calculating parameters and time and voltage measurement.
    l. Draw and construct a series RCL circuit including calculating parameters and time and voltage measurement.
    m. Draw and construct a parallel RCL circuit including calculating parameters and time and voltage measurement.
    n. Describe series and parallel resonance.

Related Academic Topics (See Appendix A):

C2, C4, C5
M2, M4
S5, S8

Workplace Skills (See Appendix B):

WP1, WP4, WP5

19

CURRICULUM FRAMEWORK

Course Name: Electrician II

Course CIP Code: 46.0302

Course Description: Electrician II is the advanced course of the secondary Electrician program. Students in this course will gain additional competencies related to safety, advanced leadership, tools, equipment, and materials/supplies, AC circuits for residential wiring, blueprints and calculations, load centers and over-current protection, rough-in, residential service, trim-out and troubleshooting, motors and controllers, programmable logic controllers, and employment skills. (2-2½ Carnegie units, depending upon time spent in the course)

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
   a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
2. Describe employment opportunities and responsibilities for electricians and related employees.
   a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
3. Describe personal and general safety rules for working in a shop/lab and industry.
   a. Describe personal safety rules for working in a shop/lab and industry including work clothing, protective clothing, safety glasses, and hearing, feet, hand, and head protection.
   b. Describe general workplace safety rules including shop/lab (work site) organization.

c. Describe the proper use of fire extinguishers and classes of fires including class A (trash and wood), B (petroleum products), C (energized electrical), and D (combustible metals).
d. Identify standard industry Safety Color Codes.
e. Describe procedures for safely handling heavy objects including using lifting devices, having straight back, lifting with legs, getting help for heavy objects, holding objects close to the body, sizing up load, and holding feet close together.
f. Describe safety practices for using climbing devices including ladders, scaffolding, and climbing belts.
g. Describe the Occupational Safety and Health Act (OSHA) and its effect on the workplace.
h. Identify the publisher, purpose, and application of the NEC.

Related Academic Topics (See Appendix A):

C2, C4

Workplace Skills (See Appendix B):

WP5

4. Describe basic electrical safety practices.
   a. Describe factors to consider in storing and/or disposing of hazardous materials including PCB's in old transformers and capacitors, volatile liquids, battery acid, explosive gases, refrigerants, and POL products.
   b. Identify hazardous materials that may be found on a job site and describe procedures for handling/avoidance or removal of materials including asbestos, PCB's, POL products, refrigerants, flammable materials, and smoke.
   c. Interpret a Materials Safety Data Sheet (MSDS).
   d. Describe basic electrical safety practices including removal of jewelry and metal objects from body, probing techniques, using insulated gloves and boots, and grounding, and personal safety devices.
   e. Describe hazards of electrical shock including effects of current, shock avoidance techniques, and shock treatment procedures.
   f. Describe accident procedures including getting help, basic first aid, cardiopulmonary resuscitation (CPR), and accident report form.
   g. Describe basic electric circuit safety methods including proper grounding, importance of third wire, and ground fault interrupters.
   h. Describe the operation of current overload devices including fuses and circuit breakers.

   Related Academic Topics (See Appendix A):

   C1, C4, C5
   S5, S6, S8

   Workplace Skills (See Appendix B):

   WP5, WP6

5. Develop advanced leadership and organizational skills.

a. Identify VICA leadership and skills competition activities including leadership skills development programs, skills competitions, and organizational skills.
b. Identify similarities between VICA leadership skills and workplace leadership skills including organizational structure, promotional opportunities, and benefits.

Related Academic Topics (See Appendix A):
C5, C6

Workplace Skills (See Appendix B):
WP1, WP3, WP6

6. Identify common tools, equipment, materials, and hardware used in electrical trades.
   a. Identify common and electrical specialty tools used in electrical trades and demonstrate the use of each tool including measuring and leveling tools, fastening tools, cutting and crimping tools, boring tools, heating tools, bending tools, volt ohmmeter (VOM), megohmmeter, and metering and test equipment.
   b. Identify classes and types of outlet boxes, devices, covers, and plates used in electrical wiring including applications of each.
   c. Identify common types of hardware used in electrical wiring including fasteners, supports, and anchors.
   d. Identify common types of conduits and their applications.

   Related Academic Topics (See Appendix A):
   C1, C3, C4

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
7. Identify conduit and wire cable working tools.
   a. Identify the types of conduit benders including hand, mechanical, and hydraulic types.
   b. Identify wire and cable pulling equipment including fish tapes.
   c. Identify conduit cutting and threading tools including saws, pipe cutters, pipe reamers, and pipe threaders.
   d. Identify knockout cutters including hand, mechanical, and hydraulic types.

   Related Academic Topics (See Appendix A):
   C1, C3, C4

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
8. Bend, cut, ream, and thread conduit and install connectors on PVC.
   a. Bend, cut, ream, and thread rigid metal conduit according to industry standards.
   b. Bend EMT including stub-ups, back to back, offset, saddle, and four point saddle.
   c. Cut, ream, offset, and install connectors on PVC according to industry standards.

Related Academic Topics (See Appendix A):

C1, C3, C4

Workplace Skills (See Appendix B):

WP1, WP4, WP5

9. Determine the type and size of conductors/cables used in the electrical trades.
   a. Describe factors that determine the type and size of conductors including type of conducting materials, load, length of wire, ambient temperature, moisture, voltage drop, and cross-sectional area.
   b. Identify types of cables used in the electrical trades according to National Electrical Code (NEC) and local codes.

Related Academic Topics (See Appendix A):

C3, C4, C5

S6

Workplace Skills (See Appendix B):

WP4, WP5, WP6

10. Determine wiring connections utilizing switching circuits to NEC and local codes.
    a. Perform sound wiring connections, including connectors, terminals, and lugs.
    b. Describe functions of switches, including visualization and building of circuits in single pole, double pole, three-way, and four-way switches.
    c. Wire electrical switching circuits including single pole, double pole, three-way, and four-way.

Related Academic Topics (See Appendix A):

C3, C4, C5

S6

Workplace Skills (See Appendix B):

WP4, WP5, WP6

11. Determine the grounding requirements according to NEC and local codes.
    a. Perform sound grounding connections as per NEC and/or local codes.
    b. Test grounding system both mechanically and electrically using proper test equipment.

Related Academic Topics (See Appendix A):

C3, C4, C5

S6

Workplace Skills (See Appendix B):

WP4, WP5, WP6

12. Identify symbols and information commonly used on blueprints used in residential electrical trades.
    a. Interpret symbols used in residential wiring commonly found in blueprint specifications.

Related Academic Topics (See Appendix A):

C1, C3, C5

M7

Workplace Skills (See Appendix B):

WP1, WP4, WP5

13. Calculate circuit loads and voltage drops according to the wiring schematic to include carriers, load, and devices.
    a. Interpret a wiring schematic to calculate circuit loads and voltage drops in dwellings.

Related Academic Topics (See Appendix A):

C2, C4

M7

Workplace Skills (See Appendix B):

WP1, WP4, WP5

14. State minimum requirements for residential outlets according to NEC.
    a. Determine minimum requirements for residential outlets.

Related Academic Topics (See Appendix A):

C1, C2, C4

M7

Workplace Skills (See Appendix B):

WP1, WP4, WP5

15. Determine the types of overcurrent protection devices, including fuses, circuit breakers, and ground fault circuit interrupts (GFCI) used in safety switches or load centers.
    a. Describe the types of overcurrent protective devices including circuit breakers and fuses of less than 600 volts.
    b. Identify installations that require GFCI protection according to NEC.
    c. Identify types of safety switches and load centers including nomenclature according to NEC.
    d. Wire a receptacle circuit to the load center according to NEC.

Related Academic Topics (See Appendix A):

C1, C2, C4

M1

Workplace Skills (See Appendix B):

WP1, WP4, WP5

16. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
    a. Identify locations where at least one receptacle is required according to NEC.
    b. Describe planning techniques when placing boxes on plans according to NEC.
    c. Explain acceptable heights for boxes in various locations according to shop standards.

d. Describe the steps in installing boxes in exterior walls to be brick veneered according to NEC.
e. Describe the required outlets for various living areas in a residence according to NEC.

Related Academic Topics (See Appendix A):

C1, C2, C4, C5
M4, M7

Workplace Skills (See Appendix B):

WP1, WP4, WP5

17. Wire electrical devices/loads in accordance with NEC and electrical floor plan.
    a. Install a device box when given cabinet height and wall covering according to NEC.
    b. Install a ceiling box when given ceiling covering thickness according to NEC.
    c. Wire a 120-volt device or receptacle according to NEC.
    d. Wire a 240-volt device or receptacle according to NEC.

    Related Academic Topics (See Appendix A):

    C1, C2, C4, C5
    M4, M7
    S6

    Workplace Skills (See Appendix B):

    WP1, WP4, WP5

18. Determine service entrance requirements.
    a. Identify parts of a service entrance according to NEC.
    b. State clearances for service drops in varying situations according to NEC.
    c. Identify the different types of grounding electrodes according to NEC.
    d. Describe service requirements for manufactured homes according to NEC.
    e. Install an overhead raceway with service entrance conductors through meter base to load center or panel with minimum of 100 amperes according to NEC.

    Related Academic Topics (See Appendix A):

    C1, C2, C3, C5
    M1
    S6

    Workplace Skills (See Appendix B):

    WP1, WP2, WP5

19. Determine the requirements for electrical trim-out and troubleshoot a residence according to NEC.
    a. Explain the grounding requirement for appliances according to NEC.
    b. Describe steps for panel trim-out including setting the panel, covers, wire termination, load balancing, labeling, and installation of wiring according to industry standard.

c. Explain troubleshooting procedures including knowing the system, identifying the problem, listing possible causes, repairing the circuit or correcting the problem, inspecting and testing the system, and activating (if possible).

d. Troubleshoot an electrical circuit including knowing the system, identifying the problem, listing possible causes, repairing the circuit or correcting the problem, inspecting and testing the system, and activating (if possible).

Related Academic Topics (See Appendix A):

C1, C2, C3, C5
M1
S6

Workplace Skills (See Appendix B):

WP1, WP2, WP5

20. Demonstrate safe procedures associated with electrical motors in new and existing systems.
    a. Perform tag and lock procedures.
    b. Select and install proper overload and overcurrent devices according to NEC.

Related Academic Topics (See Appendix A):

C1, C2, C3, C4

Workplace Skills (See Appendix B):

WP4, WP5

21. Differentiate between types/classes of electrical motors.
    a. Explain direct current motor theory of operation including series, shunt, and compound.
    b. Explain single-phase motor theory of operation including squirrel cage, capacitor start, capacitor run, shaded pole, and repulsion start-induction run.
    c. Explain three-phase motor operation including squirrel cage, synchronous, and wound rotor along with their voltages, amperages, and nameplate data.

Related Academic Topics (See Appendix A):

C1, C2, C3
S6

Workplace Skills (See Appendix B):

WP4, WP5

22. Determine speed, direction, and control of AC single- and three-phase and DC motors.
    a. Reverse rotation of an AC motor, including single-phase and three-phase.
    b. Wire multi-voltage single- and three-phase electrical motors.
    c. Wire multi-speed single- and three-phase electrical motors.

Related Academic Topics (See Appendix A):
C1, C2, C3
S6
Workplace Skills (See Appendix B):
WP4, WP5

23. Identify the physical and electrical characteristics of electrical motors.
    a. Determine physical and electrical characteristics of electrical motors.
    b. Determine electrical characteristics using nameplate data and/or NEC requirements.

Related Academic Topics (See Appendix A):
C1, C2, C3
S6
Workplace Skills (See Appendix B):
WP4, WP5

24. Identify the physical and electrical characteristics of electrical starters.
    a. Determine physical characteristics including frame size, shaft, environment, and couplings.
    b. Determine electrical characteristics using nameplate data and/or NEC requirements.

Related Academic Topics (See Appendix A):
C1, C2, C3
S6
Workplace Skills (See Appendix B):
WP4, WP5

25. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
    a. Wire single-phase manual/automatic controller for speed control and/or direction.
    b. Wire three-phase manual/automatic controller for speed control and/or direction.

Related Academic Topics (See Appendix A):
C1, C2, C3
S6
Workplace Skills (See Appendix B):
WP4, WP5

26. Describe function and application of programmable logic controls.
    a. Define terms associated with programmable logic controls including digital, analog signal, counter, discrete, fiber optics, input, logic, networking, output, programmer, and programmable logic controller.
    b. Explain programmable logic controller functions including input and output signal compared to previously programmed instructions.
    c. Identify input devices for programmable logic controllers including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.

d. Identify output devices for programmable logic controllers including motor starters, contractors, solenoids, pilot lights, and coil relays.
e. Write a basic PLC program including two and three wire controls.
f. Wire a PLC input device including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
g. Wire a PLC output device including timers, pilot lights, brakes, solenoids, starter motors, contractors, and coil relays.

Related Academic Topics (See Appendix A):

C1, C2, C3
S6
M1

Workplace Skills (See Appendix B):

WP4, WP5

27. Develop employability skills.
    a. Prepare a resume containing essential information including personal information, education, and employment experience using correct grammar, spelling, and punctuation.
    b. Complete job application forms including correct grammar, spelling, and punctuation.
    c. Explain procedures for job interviews using correct job etiquette.
    d. Demonstrate the role of an applicant in a job interview using correct interview procedures.

Related Academic Topics (See Appendix A):

C1, C3, C4, C6

Workplace Skills (See Appendix B):

WP2, WP3, WP6

SECTION II:

CURRICULUM GUIDE

FOR

ELECTRICIAN

ELECTRICIAN I

ELECTRICIAN I
UNIT 1: ORIENTATION **(5 days)**

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
   a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
2. Describe employment opportunities and responsibilities for electricians and related employees.
   a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6

Suggested Teaching Strategies:

1. *Describe local program and vocational center policies and procedures.*
   a. Review and discuss applicable rules and regulations.
2. *Describe employment opportunities and responsibilities for electricians and related employees.*
   a. Have students survey job opportunities through employer visits, resource person(s), telephone calls, help wanted ads, or a field trip with report of findings to the class.
   b. Have resource person speak to students regarding requirements for punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

Suggested Assessment Strategies:

1. *Describe local program and vocational center policies and procedures.*
   a. *Test on applicable rules and regulations.*
2. *Describe employment opportunities and responsibilities for electricians and related employees.*
   a. *Oral and written report on employment opportunities.*
   b. *Oral and written report on employee responsibilities.*

Suggested References:

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

Local Administrative Policies and Procedures.

ELECTRICIAN I
UNIT 2: SAFETY **(5 days)**

Competencies and Suggested Objectives:

1. Describe personal and general safety rules for working in a shop/lab and industry.
   a. Describe personal safety rules for working in a shop/lab and industry including work clothing, protective clothing, safety glasses, and hearing, feet, hand, and head protection.
   b. Describe general workplace safety rules including shop/lab (work site) organization.
   c. Describe the proper use of fire extinguishers and classes of fires including class A (trash and wood), B (petroleum products), C (energized electrical), and D (combustible metals).
   d. Identify standard industry Safety Color Codes.
   e. Describe procedures for safely handling heavy objects including using lifting devices, having straight back, lifting with legs, getting help for heavy objects, holding objects close to the body, sizing up load, and holding feet close together.
   f. Describe safety practices for using climbing devices including ladders, scaffolding, and climbing belts.
   g. Describe the Occupational Safety and Health Act (OSHA) and its effect on the workplace.

   Related Academic Topics (See Appendix A):
   C2, C4

   Workplace Skills (See Appendix B):
   WP5
2. Describe basic electrical safety practices.
   a. Describe factors to consider in storing and/or disposing of hazardous materials including PCB's in old transformers and capacitors, volatile liquids, battery acid, explosive gases, refrigerants, and POL products.
   b. Identify hazardous materials that may be found on a job site and describe procedures for handling/avoidance or removal of materials including asbestos, PCB's, POL products, refrigerants, flammable materials, and smoke.
   c. Interpret a Materials Safety Data Sheet (MSDS).
   d. Describe basic electrical safety practices including removal of jewelry and metal objects from body, probing techniques, using insulated gloves and boots, grounding, and personal safety devices
   e. Describe hazards of electrical shock including effects of current, shock avoidance techniques, and shock treatment procedures.

f. Describe accident procedures including getting help, basic first aid, cardiopulmonary resuscitation (CPR), and accident report form.
g. Describe basic electric circuit safety methods including proper grounding, importance of third wire, and ground fault interrupters.
h. Describe the operation of current overload devices including fuses and circuit breakers.

Related Academic Topics (See Appendix A):

C1, C4, C5
S5, S6, S8

Workplace Skills (See Appendix B):

WP5, WP6

Suggested Teaching Strategies:

1. *Describe personal and general safety rules for working in a shop/lab and industry.*
   a. *Have students review safety handout.*
   b. *Tour shop and lab and identify potential safety hazards.*
   c. *Demonstrate and/or explain uses of fire extinguishers and fire control methods for classes of fires A, B, C, and D.*
   d. *Conduct industry tour to observe safety color coding procedures.*
   e. *Have students perform and/or observe safe lifting techniques.*
   f. *Demonstrate safety practices for using climbing devices.*
   g. *Discuss OSHA and its effect on the workplace.*
2. *Describe basic electrical safety practices.*
   a. *Discuss factors to consider in storing and disposing hazardous materials.*
   b. *Identify hazardous materials that may be found on the job site.*
   c. *Provide students with MSDS sheets to identify hazardous materials that may be found on the job.*
   d. *Describe basic electrical safety practices, including removal of jewelry and metal objects from the body.*
   e. *Utilize media presentations to describe hazards of electrical shock and treatment procedures.*
   f. *Review procedures to use in case of an accident.*
   g. *Display examples of proper safety grounding methods.*
   h. *Demonstrate the operation of current overload devices.*

Suggested Assessment Strategies:

1. *Describe personal and general safety rules for working in a shop/lab and industry.*
   a. *Oral and/or written exercise.*
   b. *Oral and/or written exercise.*
   c. *Oral and/or written exercise.*

d. Oral and/or written exercise.
e. Oral and/or written exercise and performance exercise.
f. Oral and/or written exercise.
g. Oral and/or written exercise.

2. *Describe basic electrical safety practices.*
   a. Oral and/or written exercise.
   b. Oral and/or written exercise.
   c. Student identification of hazardous materials using the MSDS sheet.
   d. Observe and monitor safe practices performed by students.
   e. Oral and/or written evaluation.
   f. Oral and/or written evaluation.
   g. Oral and/or written evaluation.
   h. Oral and/or written evaluation.

Suggested References:

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

Warzecha, Mary. Hazardous Materials Fingertip Retrieval System. American Vocational Association. 1988.

ELECTRICIAN I
UNIT 3: LEADERSHIP AND PERSONAL DEVELOPMENT **(5 days)**

Competencies and Suggested Objectives:

1. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electricity trades by the Vocational Industrial Clubs of America (VICA).
   a. State procedures of leadership used in organizational meetings to reach an agreement in an orderly manner including procedures for gaining recognition in a meeting and conducting a VICA Club meeting.
   b. Describe the purposes of VICA including leadership development, personal development, and skills competition.

   Related Academic Topics (See Appendix A):
   C5, C6

   Workplace Skills (See Appendix B):
   WP1, WP3, WP6
2. Identify desirable personal behavior and characteristics for use in the electrical occupations.
   a. Identify desirable personality traits to apply when serving the public including politeness, cheerfulness, enthusiasm, efficiency, competency, friendliness, self-confidence, honesty, and integrity.
   b. Identify desirable personality traits to apply when communicating with employees, supervisors, and other employees including effective communication skills, positive attitude, honesty, integrity, loyalty, team commitment, cooperation, and ability to follow oral and written instructions.
   c. Identify desirable characteristics of the personal work ethic to apply in electrical trades including attendance, promptness, desire to achieve, loyalty, competent performance as required by employer, effective customer relations, cooperation, and obedience to rules and regulations.

   Related Academic Topics (See Appendix A):
   C4, C5, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
3. Identify legal requirement for participation in electrical occupations.
   a. Describe ways to avoid legal liability problems in electrical trades including using equipment approved by national testing organization; installing wiring to NEC, local codes, and customer specifications; and maintaining license and bonding.

Related Academic Topics (See Appendix A):
C3, C4, C6
Workplace Skills (See Appendix B):
WP4, WP6

Suggested Teaching Strategies:

1. *State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electrical trades by the Vocational Industrial Clubs of America (VICA).*
   a. *Allow students to attend a formal meeting to observe "Robert's Rules of Order" in operation. Give a hand-out on procedures for "Robert's Rules of Order." Encourage a classroom discussion concerning "Robert's Rules of Order."*
   b. *Discuss leadership opportunities for students.*
2. *Identify desirable personal behavior and characteristics for use in the electrical occupations.*
   a. *Conduct a class discussion involving desirable personality traits.*
   b. *Compare public personality traits versus employee personality traits.*
   c. *Have students interview someone outside school to identify the application of personal work ethics.*
3. *Identify legal requirement for participation in electrical occupations.*
   a. *Discuss with students liabilities that can be incurred while not meeting standards and ethics.*

Suggested Assessment Strategies:

1. *State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electrical trades by the Vocational Industrial Clubs of America (VICA).*
   a. *Oral and/or written review.*
   b. *Oral and/or written review.*
2. *Identify desirable personal behavior and characteristics for use in the electrical occupations.*
   a. *Have students role play desirable personality traits.*
   b. *Oral and/or written report.*
   c. *Oral and/or written report of interviews.*
3. *Identify legal requirement for participation in electrical occupations.*
   a. *Oral and/or written review.*

Suggested References:

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

VICA. Official Guide for VICA. Washington, DC: Vocational Industrial Clubs of America (VICA).

ELECTRICIAN I
UNIT 4: DIRECT CURRENT (DC) CIRCUITS **(50 days)**

Competencies and Suggested Objectives:

1. Describe the terms and scientific principles associated with direct current electricity.
   a. Define terms associated with the nature of matter including physical characteristics of matter (elements, compounds, atoms, electrons, protons, and neutrons).
   b. Describe laws of electrical charges including like and unlike charges.
   c. Identify electrical materials including conductors, insulators, and semiconductors.
   d. Describe methods of generating electricity including solar, chemical, mechanical, and thermal.
   e. Describe the principles and operation of batteries.
   f. Describe basic theories of current flow including electron and conventional flow methods.
   g. Describe DC circuit parameters including voltage, power, current, and resistance.
   h. Identify resistor types and values using standard resistor color codes and alphanumeric codes.
   i. Perform basic engineering notation calculations including conversion, adding, subtracting, multiplying, and dividing.
   j. Identify DC circuit schematic symbols.

   Related Academic Topics (See Appendix A):
   C1, C5, C6
   M1, M4
   S6, S8

   Workplace Skills (See Appendix B):
   WP1, WP2, WP4, WP6
2. Create circuits and measure DC electricity using the multimeter.
   a. Describe and demonstrate use of a multimeter including measuring voltage, current, and resistance.
   b. Demonstrate use of Ohm's Law to calculate circuit parameters for a series circuit including voltage, current, resistance, and power.
   c. Draw and construct a series circuit with a minimum of three resistances.
   d. Calculate and measure circuit parameters for a series circuit.
   e. Demonstrate use of Ohm's Law to calculate circuit parameters for a parallel circuit including voltage, current, resistance, and power.
   f. Draw and construct a parallel circuit with a minimum of three resistances.
   g. Calculate and measure circuit parameters for a parallel circuit.

h. Demonstrate use of Ohm's Law to calculate circuit parameters for a series-parallel circuit including voltage, current, resistance, and power.
i. Draw and construct a series-parallel circuit with a minimum of three resistances.
j. Calculate and measure circuit parameters for a series-parallel circuit.

Related Academic Topics (See Appendix A):

C1, C4, C6
M1, M4
S6, S8

Workplace Skills (See Appendix B):

WP4, WP5, WP6

3. Describe the principles of magnetism and electromagnetic properties.
   a. Describe the principles of magnetism including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.
   b. Describe the principles of electromagnetic properties including magnetic fields, polarities, core materials, permeability, motor action, induced current, and associated laws.
   c. Construct a simple electromagnet, including use of copper windings and a metal rod.

Related Academic Topics (See Appendix A):

C1, C2, C4, C5
M1,M4
S6, S8

Workplace Skills (See Appendix B):

WP4, WP5, WP6

Suggested Teaching Strategies:

1. *Describe the terms and scientific principles associated with direct current electricity.*
   a. *Give students related handouts; review video on atom; discuss and demonstrate Bohr's Model of the Atom.*
   b. *Discuss fundamental laws of electrical charges.*
   c. *Give related handouts to students; pass out examples of conductors, insulators, and semiconductors; and introduce the atomic structure of each.*
   d. *Have students research the different methods used to generate electricity.*
   e. *Display different battery types and describe differences.*
   f. *Discuss basic theories of current flow.*
   g. *Introduce current, resistance, and power and explain their relationship to each other.*

h. Pass out a selection of resistors and describe the resistor color code and alphanumeric code.
i. Review scientific notation and introduce engineering notation.

2. Create circuits and measure DC electricity using the multimeter.
a. Pass out operator's manual for related multimeter; demonstrate procedures; and allow students to participate in related lab activities.
b. Have students calculate circuit parameters from example series circuits.
c. Have students draw and construct a three resistor series circuit.
d. Have students use calculator to obtain circuit parameters for a series circuit and verify calculations by measuring circuit parameters with multimeter.
e. Have students calculate parameters from example parallel circuits.
f. Have students draw and construct a three resistor parallel circuit.
g. Have students use calculator to obtain circuit parameters for a parallel circuit and verify calculations by measuring circuit parameters with multimeter.
h. Have students calculate circuit parameters from example series/parallel circuits.
i. Have students draw and construct a three resistor series/parallel circuit.
j. Have students use calculator to obtain circuit parameters for a series/parallel circuit and verify calculations by measuring circuit parameters with multimeter.

3. Describe the principles of magnetism and electromagnetic properties.
a. View video series on magnetism and discuss observations.
b. View video series on electromagnetism and discuss observations.
c. Pass out materials and allow students to construct an electromagnet.

Suggested Assessment Strategies:

1. Describe the terms and scientific principles associated with direct current electricity.
a. Written test.
b. Oral/written test.
c. Oral/written test.
d. Oral/written report.
e. Oral/written test.
f. Oral test.
g. Oral/written test.
h. Perform lab and identify resister values.
j. oral/written test

2. Create circuits and measure DC electricity using the multimeter.
a. Observation of proper techniques.
b. Completion of student worksheet.
c. Observation and completed lab sheet.

d. Observation and completed lab sheet.
e. Completion of student worksheet with parallel circuit.
f. Observation and completed lab sheet with parallel circuit.
g. Observation and completed lab sheet with parallel circuit.
h. Observation and completed worksheet with series/parallel circuit.
i. Observation and completed lab sheet with series/parallel circuit.
j. Observation and completed lab sheet with series/parallel circuit.

3. Describe the principles of magnetism and electromagnetic properties.
a. Oral/written test.
b. Oral/written test.
c. Observation and lab sheet

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Fowler, Richard J. Electricity: Principles and Applications (3rd ed.). New York: McGraw-Hill. 1989.

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

Windham, Kenneth E. DC/AC Computer Lab Manual. New York: Glencoe/Macmillan/McGraw-Hill. 1995.

ELECTRICIAN I
UNIT 5: ALTERNATING CURRENT (AC) CIRCUITS **(65 days)**

Competencies and Suggested Objectives:

1. Describe the terms and scientific principles associated with alternating current electricity.
   a. Describe principles of AC generation including sine wave characteristics and magnetic induction.
   b. Define terms associated with AC voltage including AC frequency, period, and time.
   c. Describe sources of AC voltage including power plants (hydroelectric, fossil fuel, solar, wind, and nuclear power) and generators.
   d. Describe distribution route and components used from power plant to home or business including transmission lines, transformers, substations, and service entrances.
   e. Describe the properties and characteristics of inductors including inductance, physical properties, DC and AC characteristics, units, current, and frequency.
   f. Describe the properties and characteristics of transformers including rating, types, uses, turns ratio, and connections.
   g. Describe properties and characteristics of capacitors including capacitance, physical properties of capacitors, DC and AC electrical characteristics, units, and reactance.
   h. Describe differences in phases in electrical power supply, including single-phase, double-phase, and 3-phase.

   Related Academic Topics (See Appendix A):
   C1, C2, C4,C5
   M1, M2
   S5, S8

   Workplace Skills (See Appendix B):
   WP2, WP5, WP6
2. Display and measure AC waveforms using the oscilloscope and function generator.
   a. Demonstrate the use of an oscilloscope including safety and measurement of DC and AC voltages and time.
   b. Demonstrate the use of a function generator including safety, square wave, sine wave, sawtooth wave, frequency, and amplitude.

Related Academic Topics (See Appendix A):

C2, C4, C5
M2, M4
S5, S8

Workplace Skills (See Appendix B):

WP1, WP4, WP5

3. Describe and construct series and parallel circuits.
   a. Draw and construct a series resistive circuit, calculating parameters and discussing phase relationship.
   b. Draw and construct a parallel resistive circuit, calculating parameters and discussing phase relationship.
   c. Draw and construct a series inductive circuit including calculating parameters and time and voltage measurement in a circuit with two inductors.
   d. Draw and construct a parallel inductive circuit including calculating parameters and time and voltage measurement in a circuit with two inductors.
   e. Draw and construct a series RL circuit including calculating parameters and time and voltage measurement.
   f. Draw and construct a parallel RL circuit including calculating parameters and time and voltage measurement.
   g. Draw and construct a series capacitive circuit including calculating parameters and time and voltage measurement of a circuit with two capacitors.
   h. Draw and construct a parallel capacitive circuit including calculating parameters and time and voltage measurement of a circuit with two capacitors.
   i. Draw and construct a series RC circuit including calculating parameters and time and voltage measurement.
   j. Draw and construct a parallel RC circuit including calculating parameters and time and voltage measurement.
   k. Draw RL and RC time constants including calculating parameters and time and voltage measurement.
   l. Draw and construct a series RCL circuit including calculating parameters and time and voltage measurement.
   m. Draw and construct a parallel RCL circuit including calculating parameters and time and voltage measurement.
   n. Describe series and parallel resonance.

Related Academic Topics (See Appendix A):

C2, C4, C5
M2, M4
S5, S8

Workplace Skills (See Appendix B):

WP1, WP4, WP5

Suggested Teaching Strategies:

1. *Describe the terms and scientific principles associated with alternating current electricity.*
   a. *Pass out handouts and view videos on AC generation.*
   b. *Pass out handouts and review terms and definitions.*
   c. *Have students research AC voltage sources and prepare reports.*
   d. *Use student handouts and videos with classroom discussion and tour of a power distribution system.*
   e. *Use student handouts and videos with classroom discussion.*
   f. *Use student handouts and videos with classroom discussion.*
   g. *Use student handouts and videos with classroom discussion.*
   h. *Use student handouts and conference with visual demonstration.*
   i. *Use student handouts with classroom discussion.*
2. *Measure AC electricity using the oscilloscope and function generator.*
   a. *Pass out operation manual and block diagram and discuss front panel control and measurement of time and amplitude.*
   b. *Pass out operation manual and block diagram and discuss front panel controls and output waveform.*
3. *Describe and construct series and parallel circuits.*
   a. *Student handouts, conference, and student worksheet computer assignment.*
   b. *Student handouts, conference, and student worksheet computer assignment.*
   c. *Describe series inductive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   d. *Describe parallel inductive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   e. *Describe series RL circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   f. *Describe parallel RL circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   g. *Describe series capacitive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   h. *Describe parallel capacitive circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   i. *Describe series RC circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   j. *Describe parallel RC circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*
   k. *Describe series RL and RC time constant circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.*

l. Describe series RCL circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.
m. Describe parallel RCL circuits and pass out worksheet for student to draw and construct circuit. Make time/voltage measurement.
n. Describe applications of series and parallel resonance.

Suggested Assessment Strategies:

1. *Describe the terms and scientific principles associated with alternating current electricity.*
   a. Written test.
   b. Oral/written report.
   c. Oral/written report.
   d. Oral/written report.
   e. Oral/written report.
   f. Oral/written report.
   g. Oral/written test.
   h. Oral/written report.
   i. Oral/written report.
2. *Measure AC electricity using the oscilloscope and function generator.*
   a. Practical application with lab sheet.
   b. Practical application with lab sheet.
3. *Describe and construct series and parallel circuits.*
   a. Observation and completed lab sheets with AC series resistive circuits.
   b. Observation and completed lab sheets with AC parallel resistive circuits.
   c. Practical application with lab sheet.
   d. Practical application with lab sheet.
   e. Practical application with lab sheet.
   f. Practical application with lab sheet.
   g. Practical application with lab sheet.
   h. Practical application with lab sheet.
   i. Practical application with lab sheet.
   j. Practical application with lab sheet.
   k. Practical application with lab sheet.
   l. Practical application with lab sheet.
   m. Practical application with lab sheet.
   n. Oral or written test.

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Fowler, Richard J. Electricity: Principles and Applications (3rd ed.). New York: McGraw-Hill. 1989.

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

Windham, Kenneth E. DC/AC Computer Lab Manual. New York: Glencoe/Macmillan/McGraw-Hill. 1995.

ELECTRICIAN II

ELECTRICIAN II
UNIT 1: ORIENTATION **(1 day)**

Competencies and Suggested Objectives:

1. Describe local program and vocational center policies and procedures.
   a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6
2. Describe employment opportunities and responsibilities for electricians and related employees.
   a. Describe employment opportunities available for electricians, electronics technicians, and electrical related employees including potential earnings, employee benefits, job availability, possible places of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities including punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

   Related Academic Topics (See Appendix A):
   C1, C4, C6

   Workplace Skills (See Appendix B):
   WP2, WP3, WP6

Suggested Teaching Strategies:

1. *Describe local program and vocational center policies and procedures.*
   a. Review and discuss applicable rules and regulations.
2. *Describe employment opportunities and responsibilities for electricians and related employees.*
   a. Have students survey job opportunities through employer visits, resource person(s), telephone calls, help wanted ads, or a field trip with report of findings to the class.
   b. Have resource person speak to students regarding requirements for punctuality, physical requirements, customer relations, following directions, job safety, and entry level skills.

Suggested Assessment Strategies:

1. *Describe local program and vocational center policies and procedures.*
   a. *Test on applicable rules and regulations.*
2. *Describe employment opportunities and responsibilities for electricians and related employees.*
   a. *Oral and written report on employment opportunities.*
   b. *Oral and written report on employee responsibilities.*

Suggested References:

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

Local Administrative Policies and Procedures.

ELECTRICIAN II
UNIT 2: SAFETY (REVIEW) **(4 days)**

Competencies and Suggested Objectives:

1. Describe personal and general safety rules for working in a shop/lab and industry.
   a. Describe personal safety rules for working in a shop/lab and industry including work clothing, protective clothing, safety glasses, and hearing, feet, hand, and head protection.
   b. Describe general workplace safety rules including shop/lab (work site) organization.
   c. Describe the proper use of fire extinguishers and classes of fires including class A (trash and wood), B (petroleum products), C (energized electrical), and D (combustible metals).
   d. Identify standard industry Safety Color Codes.
   e. Describe procedures for safely handling heavy objects including using lifting devices, having straight back, lifting with legs, getting help for heavy objects, holding objects close to the body, sizing up load, and holding feet close together.
   f. Describe safety practices for using climbing devices including ladders, scaffolding, and climbing belts.
   g. Describe the Occupational Safety and Health Act (OSHA) and its effect on the workplace.
   h. Identify the publisher, purpose, and application of the NEC.

   Related Academic Topics (See Appendix A):
   C2, C4

   Workplace Skills (See Appendix B):
   WP5
2. Describe basic electrical safety practices.
   a. Describe factors to consider in storing and disposing of hazardous materials including PCB's in old transformers and capacitors, volatile liquids, battery acid, explosive gases, refrigerants, and POL products.
   b. Identify hazardous materials that may be found on a job site and describe procedures for handling/avoidance or removal of materials including asbestos, PCB's, POL products, refrigerants, flammable materials, and smoke.
   c. Interpret a Materials Safety Data Sheet (MSDS).
   d. Describe basic electrical safety practices including removal of jewelry and metal objects from body, probing techniques, using insulated gloves and boots, and grounding, and personal safety devices.
   e. Describe hazards of electrical shock including effects of current, shock avoidance techniques, and shock treatment procedures.

f. Describe accident procedures including getting help, basic first aid, cardiopulmonary resuscitation (CPR), and accident report form.
g. Describe basic electric circuit safety methods including proper grounding, importance of third wire, and ground fault interrupters.
h. Describe the operation of current overload devices including fuses and circuit breakers.

Related Academic Topics (See Appendix A):

C1, C4, C5
S5, S6, S8

Workplace Skills (See Appendix B):

WP5, WP6

Suggested Teaching Strategies:

1. *Describe personal and general safety rules for working in a shop/lab and industry.*
   a. *Have students review safety handout.*
   b. *Tour shop and lab and identify potential safety hazards.*
   c. *Demonstrate and/or explain uses of fire extinguishers and fire control methods for classes of fires A, B, C, and D.*
   d. *Conduct industry tour to observe safety color coding procedures.*
   e. *Have students perform and/or observe safe lifting techniques.*
   f. *Demonstrate safety practices for using climbing devices.*
   g. *Discuss OSHA and its effect on the workplace.*
2. *Describe basic electrical safety practices.*
   a. *Discuss factors to consider in storing and disposing hazardous materials.*
   b. *Identify hazardous materials that may be found on the job site.*
   c. *Provide students with MSDS sheets to identify hazardous materials that may be found on the job.*
   d. *Describe basic electrical safety practices, including removal of jewelry and metal objects from the body.*
   e. *Utilize media presentations to describe hazards of electrical shock and treatment procedures.*
   f. *Review procedures to use in case of an accident.*
   g. *Display examples of proper safety grounding methods.*
   h. *Demonstrate the operation of current overload devices.*

Suggested Assessment Strategies:

1. *Describe personal and general safety rules for working in a shop/lab and industry.*
   a. *Oral and/or written exercise.*
   b. *Oral and/or written exercise.*
   c. *Oral and/or written exercise.*

d. Oral and/or written exercise.
e. Oral and/or written exercise and performance exercise.
f. Oral and/or written exercise.
g. Oral and/or written exercise.

2. Describe basic electrical safety practices.
a. Oral and/or written exercise.
b. Oral and/or written exercise.
c. Student identification of hazardous materials using the MSDS sheet.
d. Observe and monitor safe practices performed by students.
e. Oral and/or written evaluation.
f. Oral and/or written evaluation.
g. Oral and/or written evaluation.
h. Oral and/or written evaluation.

Suggested References:

Grob, B. Basic Electronics (7th ed.). New York: Glencoe/McGraw-Hill. 1992.

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

Warzecha, Mary. (1988). Hazardous Materials Fingertip Retrieval System. American Vocational Association.

ELECTRICIAN II
UNIT 3: ADVANCED LEADERSHIP **(5 days)**

Competencies and Suggested Objectives:

1. Develop advanced leadership and organizational skills.
   a. Identify VICA leadership and skills competition activities including leadership skills development programs, skills competitions, and organizational skills.
   b. Identify similarities between VICA leadership skills and workplace leadership skills including organizational structure, promotional opportunities, and benefits.

   Related Academic Topics (See Appendix A):
   C5, C6

   Workplace Skills (See Appendix B):
   WP1, WP3, WP6

Suggested Teaching Strategies:

1. *Develop advanced leadership and organizational skills.*
   a. *Introduce VICA Professional Development Program (PDP). Give handouts on applicable skills competitions. Conduct first organizational meeting.*
   b. *Invite guest speakers from industry and State VICA officers to discuss leadership skills.*

Suggested Assessment Strategies:

1. *Develop advanced leadership and organizational skills.*
   a. *Observe VICA organizational meeting held by students.*
   b. *Oral/written report.*

Suggested References:

VICA. Official Guide for VICA. Washington, DC: Vocational Industrial Clubs of America (VICA).

ELECTRICIAN II
UNIT 4: TOOLS, EQUIPMENT, AND MATERIALS/SUPPLIES (10 days)

Competencies and Suggested Objectives:

1. Identify common tools, equipment, materials, and hardware used in electrical trades.
   a. Identify common and electrical specialty tools used in electrical trades and demonstrate the use of each tool including measuring and leveling tools, fastening tools, cutting and crimping tools, boring tools, heating tools, bending tools, volt ohmmeter (VOM), megohmmeter, and metering and test equipment.
   b. Identify classes and types of outlet boxes, devices, covers, and plates used in electrical wiring including applications of each.
   c. Identify common types of hardware used in electrical wiring including fasteners, supports, and anchors.
   d. Identify common types of conduits and their applications.

   Related Academic Topics (See Appendix A):
   C1, C3, C4

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
2. Identify conduit and wire cable working tools.
   a. Identify the types of conduit benders including hand, mechanical, and hydraulic types.
   b. Identify wire and cable pulling equipment including fish tapes.
   c. Identify conduit cutting and threading tools including saws, pipe cutters, pipe reamers, and pipe threaders.
   d. Identify knockout cutters including hand, mechanical, and hydraulic types.

   Related Academic Topics (See Appendix A):
   C1, C3, C4

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
3. Bend, cut, ream, and thread conduit and install connectors on PVC.
   a. Bend, cut, ream, and thread rigid metal conduit according to industry standards.
   b. Bend EMT including stub-ups, back to back, offset, saddle, and four point saddle.
   c. Cut, ream, offset, and install connectors on PVC according to industry standards.

   Related Academic Topics (See Appendix A):
   C1, C3, C4

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5

Suggested Teaching Strategies:

1. *Identify common tools, equipment, materials, and hardware used in electrical trades.*
   a. *Review and discuss common tools.*
   b. *Review and discuss common materials.*
   c. *Review and discuss common types of hardware.*
   d. *Review and discuss common types of conduits.*
2. *Identify conduit and wire cable working tools.*
   a. *Discuss the various types of conduit binders.*
   b. *Discuss wire and cable pulling equipment.*
   c. *Discuss conduit cutting and threading tools.*
   d. *Discuss knockout cutters.*
3. *Bend, cut, ream, and thread conduit and install connectors on PVC.*
   a. *Demonstrate how to bend, cut , ream, and thread rigid metal conduit.*
   b. *Demonstrate how to bend EMT.*
   c. *Demonstrate how to cutream, offset, and install connectors on PVC.*

Suggested Assessment Strategies:

1. *Identify common tools, equipment, materials, and hardware used in electrical trades.*
   a. *Oral/written test.*
   b. *Oral/written test.*
   c. *Oral/written test.*
   d. *Oral/written test.*
2. *Identify conduit and wire cable working tools..*
   a. *Oral/written test.*
   b. *Oral/written test.*
   c. *Oral/written test.*
   d. *Oral/written test.*
3. *Bend, cut, ream, and thread conduit and install connectors on PVC.*
   a. *Application.*
   b. *Application.*
   c. *Application.*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 5: AC CIRCUITS FOR RESIDENTIAL WIRING **(25 days)**

Competencies and Suggested Objectives:

1. Determine the type and size of conductors/cables used in the electrical trades.
   a. Describe factors that determine the type and size of conductors including type of conducting materials, load, length of wire, ambient temperature, moisture, voltage drop, and cross-sectional area.
   b. Identify types of cables used in the electrical trades according to National Electrical Code (NEC) and local codes.

   Related Academic Topics (See Appendix A):
   C3, C4, C5
   S6

   Workplace Skills (See Appendix B):
   WP4, WP5, WP6
2. Determine wiring connections utilizing switching circuits to NEC and local codes.
   a. Perform sound wiring connections, including connectors, terminals, and lugs.
   b. Describe functions of switches, including visualization and building of circuits in single pole, double pole, three-way, and four-way switches.
   c. Wire electrical switching circuits including single pole, double pole, three-way, and four-way.

   Related Academic Topics (See Appendix A):
   C3, C4, C5
   S6

   Workplace Skills (See Appendix B):
   WP4, WP5, WP6
3. Determine the grounding requirements according to NEC and local codes.
   a. Perform sound grounding connections as per NEC and/or local codes.
   b. Test grounding system both mechanically and electrically using proper test equipment.

   Related Academic Topics (See Appendix A):
   C3, C4, C5
   S6

   Workplace Skills (See Appendix B):
   WP4, WP5, WP6

Suggested Teaching Strategies:

1. *Determine the type and size of conductors/cables used in the electrical trades.*
   a. *Pass out handouts and review terms, types, and sizes.*
   b. *Review materials in NEC.*
2. *Determine wiring connections utilizing switching circuits to NEC and local codes.*
   a. *Pass out handouts on wiring connections.*
   b. *Demonstrate use of connectors, terminals, and lugs.*
   c. *Utilize a display board of connections and circuits.*
   d. *Pass out handouts on safety procedures.*
3. *Determine grounding requirements according to NEC and local codes.*
   a. *Distribute handouts on codes.*
   b. *Discuss and demonstrate grounding techniques.*
   c. *Review and discuss NEC and local codes.*

Suggested Assessment Strategies:

1. *Determine the type and size of conductors/cables used in the electrical trades.*
   a. *Oral/written test.*
   b. *Oral/written test.*
2. *Determine wiring connections utilizing switching circuits to NEC and local codes.*
   a. *Student demonstration of wiring connections.*
   b. *Student demonstration of use of connectors, terminals, and lugs.*
   c. *Oral/written test.*
   d. *Written test.*
3. *Determine grounding requirements according to NEC and local codes.*
   a. *Student demonstration of typical grounding procedures.*
   b. *Oral/written test.*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd. ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 6: BLUEPRINTS AND CALCULATIONS **(10 days)**

Competencies and Suggested Objectives:

1. Identify symbols and information commonly used on blueprints used in residential electrical trades.
   a. Interpret symbols used in residential wiring commonly found in blueprint specifications.

   Related Academic Topics (See Appendix A):
   C1, C3, C5
   M7

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
2. Calculate circuit loads and voltage drops according to the wiring schematic to include carriers, load, and devices.
   a. Interpret a wiring schematic to calculate circuit loads and voltage drops in dwellings.

   Related Academic Topics (See Appendix A):
   C2, C4
   M7

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
3. State minimum requirements for residential outlets according to NEC.
   a. Determine minimum requirements for residential outlets.

   Related Academic Topics (See Appendix A):
   C1, C2, C4
   M7

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5

Suggested Teaching Strategies:

1. *Identify symbols and information commonly found on blueprints used in residential electrical trades.*
   a. Pass out residential symbols handout and discuss the use of symbols and their meaning.
2. *Calculate circuit loads and voltage drops according to the wiring schematic to include carriers, loads, and devices.*
   a. Pass out a wiring schematic and discuss the procedures for loads and voltage drops.
3. *State minimum requirements for residential outlets according to NEC.*
   a. Pass out handouts on NEC minimum requirements.

Suggested Assessment Strategies:

1. *Identify symbols and information commonly found on blueprints used in residential electrical trades.*
   a. *Written test.*
2. *Calculate circuit loads and voltage drops according to the wiring schematic to include carriers, loads, and devices.*
   a. *Written test.*
3. *State minimum requirements for residential outlets according to NEC.*
   a. *Written test.*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 7: LOAD CENTERS AND OVERCURRENT PROTECTION **(5 days)**

Competencies and Suggested Objectives:

1. Determine the types of overcurrent protection devices, including fuses, circuit breakers, and ground fault circuit interrupts (GFCI) used in safety switches or load centers.
   a. Describe the types of overcurrent protective devices including circuit breakers and fuses of less than 600 volts.
   b. Identify installations that require GFCI protection according to NEC.
   c. Identify types of safety switches and load centers including nomenclature according to NEC.
   d. Wire a receptacle circuit to the load center according to NEC.

   Related Academic Topics (See Appendix A):
   C1, C2, C4
   M1

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5

Suggested Teaching Strategies:

1. *Determine the types of overcurrent protection devices, including fuses, circuit breakers, and ground fault circuit interrupts (GFCI) used in safety switches or load centers.*
   a. Pass out handouts.
   b. Review material in NEC.
   c. Discuss protection devices.
   d. Demonstrate how to wire a receptacle.

Suggested Assessment Strategies:

1. *Determine the types of overcurrent protection devices, including fuses, circuit breakers, and ground fault circuit interrupts (GFCI) used in safety switches or load centers.*
   a. Written test.
   b. Oral test.
   c. Oral test.
   d. Wire a receptacle to meet NEC.

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 8: ROUGH-IN **(10 days)**

Competencies and Suggested Objectives:

1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
   a. Identify locations where at least one receptacle is required according to NEC.
   b. Describe planning techniques when placing boxes on plans according to NEC.
   c. Explain acceptable heights for boxes in various locations according to shop standards.
   d. Describe the steps in installing boxes in exterior walls to be brick veneered according to NEC.
   e. Describe the required outlets for various living areas in a residence according to NEC.

   Related Academic Topics (See Appendix A):
   C1, C2, C4, C5
   M4, M7

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5
2. Wire electrical devices/loads in accordance with NEC and electrical floor plan.
   a. Install a device box when given cabinet height and wall covering according to NEC.
   b. Install a ceiling box when given ceiling covering thickness according to NEC.
   c. Wire a 120-volt device or receptacle according to NEC.
   d. Wire a 240-volt device or receptacle according to NEC.

   Related Academic Topics (See Appendix A):
   C1, C2, C4, C5
   M4, M7
   S6

   Workplace Skills (See Appendix B):
   WP1, WP4, WP5

Suggested Teaching Strategies:

1. *Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.*
   a. Pass out handout.
   b. Review NEC requirements.
   c. Discuss planning of receptacles.

64

d. Describe procedures for placing boxes in various residential structures.
e. Field trip to residence under construction.

2. *Wire electrical devices/loads in accordance with NEC and electrical floor plan.*
   a. Demonstrate how to install a box meeting NEC requirements.
   b. Discuss floor plan.
   c. Demonstrate how to wire a 120-volt and a 240-volt device.
   d. Review NEC.

Suggested Assessment Strategies:

1. *Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.*
   a. Written test.
   b. Oral/written test.
   c. Written test.
   d. Written test.
   e. Oral test.
2. *Wire electrical device/loads in accordance with NEC and electrical floor plan.*
   a. Observation and checksheet.
   b. Oral test.
   c. Observation and checksheet.
   d. Written test.

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 9: RESIDENTIAL SERVICE **(5 days)**

Competencies and Suggested Objectives:

1. Determine service entrance requirements.
   a. Identify parts of a service entrance according to NEC.
   b. State clearances for service drops in varying situations according to NEC.
   c. Identify the different types of grounding electrodes according to NEC.
   d. Describe service requirements for manufactured homes according to NEC.
   e. Install an overhead raceway with service entrance conductors through meter base to load center or panel with minimum of 100 amperes according to NEC.

   Related Academic Topics (See Appendix A):
   C1, C2, C3, C5
   M1
   S6

   Workplace Skills (See Appendix B):
   WP1, WP2, WP5

Suggested Teaching Strategies:

1. *Determine service entrance requirements.*
   a. *Pass out handouts.*
   b. *Review NEC.*
   c. *Discuss parts of service entrances for all types of dwellings.*
   d. *Discuss types of grounding electrodes.*
   e. *Demonstrate how to install overhead raceway with service entrance electrodes through meter base using a minimum of 100 amperes.*

Suggested Assessment Strategies:

1. *Determine service entrance requirements.*
   a. *Field trip.*
   b. *Written test.*
   c. *Written test.*
   d. *Oral/written test.*
   e. *Students lay out service entrance (written form.)*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 10: TRIM-OUT AND TROUBLESHOOTING **(15 days)**

Competencies and Suggested Objectives:

1. Determine the requirements for electrical trim-out and troubleshoot a residence according to NEC.
   a. Explain the grounding requirement for appliances according to NEC.
   b. Describe steps for panel trim-out including setting the panel, covers, wire termination, load balancing, labeling, and installation of wiring according to industry standard.
   c. Explain troubleshooting procedures including knowing the system, identifying the problem, listing possible causes, repairing the circuit or correcting the problem, inspecting and testing the system, and activating (if possible).
   d. Troubleshoot an electrical circuit including knowing the system, identifying the problem, listing possible causes, repairing the circuit or correcting the problem, inspecting and testing the system, and activating (if possible).

   Related Academic Topics (See Appendix A):
   C1, C2, C3, C5
   M1
   S6

   Workplace Skills (See Appendix B):
   WP1, WP2, WP5

Suggested Teaching Strategies:

1. *Determine the requirements for electrical trim-out and troubleshoot a residence according to NEC.*
   a. Discuss NEC.
   b. Illustrate the steps for trim-out.
   c. Discuss troubleshooting procedures.
   d. Demonstrate procedures for troubleshooting an electrical system in a residence.

Suggested Assessment Strategies:

1. *Determine the requirements for electrical trim-out and troubleshoot a residence according to NEC.*
   a. Written test.
   b. Performance of the steps in a typical trim-out.

c. Oral/written test.
d. Performance check sheet on a troubleshooting procedure.

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 11: MOTORS AND CONTROLLERS **(20 days)**

Competencies and Suggested Objectives:

1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
   a. Perform tag and lock procedures.
   b. Select and install proper overload and overcurrent devices according to NEC.

   Related Academic Topics (See Appendix A):
   C1, C2, C3, C4
   Workplace Skills (See Appendix B):
   WP4, WP5
2. Differentiate between types/classes of electrical motors.
   a. Explain direct current motor theory of operation including series, shunt, and compound.
   b. Explain single-phase motor theory of operation including squirrel cage, capacitor start, capacitor run, shaded pole, and repulsion start-induction run.
   c. Explain three-phase motor operation including squirrel cage, synchronous, and wound rotor along with their voltages, amperages, and nameplate data.

   Related Academic Topics (See Appendix A):
   C1, C2, C3
   S6
   Workplace Skills (See Appendix B):
   WP4, WP5
3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
   a. Reverse rotation of an AC motor, including single-phase and three-phase.
   b. Wire multi-voltage single- and three-phase electrical motors.
   c. Wire multi-speed single- and three-phase electrical motors.

   Related Academic Topics (See Appendix A):
   C1, C2, C3
   S6
   Workplace Skills (See Appendix B):
   WP4, WP5
4. Identify the physical and electrical characteristics of electrical motors.
   a. Determine physical and electrical characteristics of electrical motors.
   b. Determine electrical characteristics using nameplate data and/or NEC requirements.

Related Academic Topics (See Appendix A):
C1, C2, C3, S6
Workplace Skills (See Appendix B):
WP4, WP5

5. Identify the physical and electrical characteristics of electrical starters.
   a. Determine physical characteristics including frame size, shaft, environment, and couplings.
   b. Determine electrical characteristics using nameplate data and/or NEC requirements.

   Related Academic Topics (See Appendix A):
   C1, C2, C3
   S6
   Workplace Skills (See Appendix B):
   WP4, WP5
6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.
   a. Wire single-phase manual/automatic controller for speed control and/or direction.
   b. Wire three-phase manual/automatic controller for speed control and/or direction.

   Related Academic Topics (See Appendix A):
   C1, C2, C3
   S6
   Workplace Skills (See Appendix B):
   WP4, WP5

Suggested Teaching Strategies:

1. *Demonstrate safe procedures associated with electrical motors in new and existing systems.*
   a. Discuss tag and lock procedures.
   b. Demonstrate selection and installation of overload and overcurrent devices.
2. *Differentiate between types/classes of electrical motors.*
   a. Discuss DC motor theory.
   b. Discuss single-phase motor theory of operation.
   c. Discuss three-phase motor operation.
3. *Determine speed, direction, and control of AC single- and three-phase and DC motors.*
   a. Demonstrate how to reverse a single-phase and a three-phase motor.
   b. Demonstrate how to wire multi-voltage single- and three-phase motors.
   c. Demonstrate how to wire single- and three-phase motors.

4. *Identify the physical and electrical characteristics of electrical starters.*
   a. *Discussion of the physical and electrical characteristics.*
   b. *Discussion of nameplate data.*
5. *Identify the physical and electrical characteristics of electrical starters.*
   a. *Discussion of parts.*
   b. *Review NEC.*
6. *Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.*
   a. *Demonstrate wiring the motors.*
   b. *Mock-up.*

Suggested Assessment Strategies:

1. *Demonstrate safe procedures associated with electrical motors in new and existing systems.*
   a. *Written test on NEC.*
   b. *Written test.*
2. *Differentiate between types/classes of electrical motors.*
   a. *Oral test.*
   b. *Oral test.*
   c. *Oral test.*
3. *Determine speed, direction, and control of AC single- and three-phase and DC motors.*
   a. *Written test.*
   b. *Application using a checksheet.*
   c. *Application using a checksheet.*
4. *Identify the physical and electrical characteristics of electrical motors.*
   a. *Written test.*
   b. *Written test.*
5. *Identify the physical and electrical characteristics of electrical starters.*
   a. *Written test.*
   b. *Written test.*
6. *Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.*
   a. *Application using a checksheet.*
   b. *Application using a checksheet.*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 12: PROGRAMMABLE LOGIC CONTROLLERS (PLC) **(20 days)**

Competencies and Suggested Objectives:

1. Describe function and application of programmable logic controls.
   a. Define terms associated with programmable logic controls including digital, analog signal, counter, discrete, fiber optics, input, logic, networking, output, programmer, and programmable logic controller.
   b. Explain programmable logic controller functions including input and output signal compared to previously programmed instructions.
   c. Identify input devices for programmable logic controllers including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
   d. Identify output devices for programmable logic controllers including motor starters, contractors, solenoids, pilot lights, and coil relays.
   e. Write a basic PLC program including two and three wire controls.
   f. Wire a PLC input device including pushbutton switches, limit switches, proximity switches, timers, photoelectric cells, and flow switches.
   g. Wire a PLC output device including timers, pilot lights, brakes, solenoids, starter motors, contractors, and coil relays.

   Related Academic Topics (See Appendix A):
   C1, C2, C3
   S6
   M1

   Workplace Skills (See Appendix B):
   WP4, WP5

Suggested Teaching Strategies:

1. *Describe function and application of programmable logic controls (PLC).*
   a. Discussion of terms.
   b. Discussion of the PLC functions.
   c. Demonstration and discussion of input devices.
   d. Demonstration and discussion of output devices.
   e. Demonstrate how to write a basic PLC program for two and three wire controls.
   f. Demonstration and discussion of wiring a PLC input device.
   g. Demonstration and discussion of wiring a PLC output device.

Suggested Assessment Strategies:

1. *Describe function and application of programmable logic control (PLC)*
   a. *Written test.*
   b. *Written test.*
   c. *Application using a checksheet.*
   d. *Written test.*
   e. *Application using a checksheet.*
   f. *Written test.*
   g. *Written test.*

Suggested References:

Food and Energy Council. Computerized Instructional Wiring Program. [Computer software]. Columbia, MO: Author.

Holzman, Harvey H. Modern Residential Wiring. South Holland, IL: Goodheart-Willcox. 1991.

Kaltwasser, S.; Flowers, G.; & Blasingame, D. Basic Wiring (2nd ed.). Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1994.

National Electrical Code. Boston, MA: National Fire Protection Association. 1993.

ELECTRICIAN II
UNIT 13: EMPLOYABILITY SKILLS **(5 days)**

Competencies and Suggested Objectives:

1. Develop employability skills.
   a. Prepare a resume containing essential information including personal information, education, and employment experience using correct grammar, spelling, and punctuation.
   b. Complete job application forms including correct grammar, spelling, and punctuation.
   c. Explain procedures for job interviews using correct job etiquette.
   d. Demonstrate the role of an applicant in a job interview using correct interview procedures.

   Related Academic Topics (See Appendix A):
   C1, C3, C4, C6
   Workplace Skills (See Appendix B):
   WP2, WP3, WP6

Suggested Teaching Strategies:

1. *Develop employability skills.*
   a. *Assist guidance counselor in presenting resume writing.*
   b. *Assist guidance counselor or industry personnel manager in completing job application form.*
   c. *Assist guidance counselor or industry personnel manager in proper procedures for job interviews.*
   d. *Role play job interviews with instructor, counselor, or personnel manager.*

Suggested Assessment Strategies:

1. *Develop employability skills.*
   a. *Evaluate student resume.*
   b. *Evaluate student job application.*
   c. *Observance of role play.*
   d. *Oral or written report.*

Suggested References:

Hartman, L. Basic Electronics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1987.

SECTION III:

RECOMMENDED TOOLS AND EQUIPMENT

RECOMMENDED TOOLS AND EQUIPMENT FOR ELECTRICIAN

1. Rule, folding (10)
2. Screwdriver set, flat blade (10)
3. Screwdriver set, Phillips (10)
4. Pliers, slip-joint (10)
5. Wrench, channel-lock (10)
6. Hammer, ball peen (10)
7. Hacksaw (5)
8. Saw, keyhole (10)
9. File set (2)
10. Chisel (10)
11. Center punch (10)
12. Bolt cutter (1)
13. Hex key set (10)
14. Magnetic torpedo level (10)
15. Knockout punch set (1)
16. Hole saw and Arbor set (1)
17. Drill brace (2)
18. Ship auger drill bit set (2)
19. Tap tool (10)
20. Electric drill, 3/8" (reversible, variable speed) (1)
21. Electric drill, 1/2" (reversible, variable speed) (1)
22. Battery powered drill driver w/1/2" keyless chuck (1)
23. Drill bit set (2)
24. Reciprocating saw (1)
25. Screw holding screwdriver, large (1)
26. Screw holding screwdriver, small (1)
27. Needle nose pliers (20)
28. Lineman's pliers (10)
29. Soldering iron (25w) (10)
30. Adjustable wire strippers (10)
31. Cutting/crimping tool (10)
32. Tool pouch (10)
33. Circuit tester (10)
34. Conduit reamer (1)
35. Nut driver set (10)
36. Cable bender (1)
37. Fuse puller (10)
38. Safety glasses and goggles (1/student)
39. Electrician's hammer (10)
40. Cable cutter (1)
41. Heat gun (1300w) (1)

42. Drop chain (1)
43. Steel fish tape and reel (1)
44. Pulling grip - sleeve set (1)
45. Pipe reamer (1)
46. Combination conduit/EMT bender set (1)
47. Hickey bender set (1)
48. Electrician's knife (10)
49. Rubber gloves (1 pair/10 students)
50. Torque screwdriver set (10)
51. Torque wrench (1)
52. Rubber hose (line hose) (1)
53. Rubber blanket (1)
54. Capacitor/inductor analyzer (10)
55. Current probe (10)
56. DC power source (10)
57. Electrical resistance/insulation tester (1)
58. Frequency counter (10)
59. Function generator (10)
60. Ground fault tester (1)
61. High potential tester (1)
62. Isolation transformer (10)
63. Logic analyzer (10)
64. Logic probes (10)
65. Logic pulser (10)
66. Multimeters (digital and analog) (10)
67. Oscilloscopes (10)
68. Semiconductor testers (10)
69. Soldering/desoldering equipment (10)
70. Voltage isolation transformers (adjustable) (5)
71. Drill press (1)
72. Architect's scales (10)
73. Clamp-on amp meters (5)
74. Megometer (1)
75. Hammer-drill (1)
76. PLC (1 min)
77. Single-phase motors (3)
    Two speed (1)
    Dual voltage (1)
    Reversing (1)
78. Three-phase motors (3)
    Two speed (1)
    Dual voltage (1)
    Reversing (1)

79. Single-phase controllers (2)
    Two speed (1)
    Reversing (1)
80. Full voltage magnetic three-phase controllers (2)
    Two speed (1)
    Reversing (1)
81. Full voltage magnetic controller (1)

APPENDIX A:

RELATED ACADEMIC TOPICS

APPENDIX A

RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

C1 Interpret written material.
C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
C3 Listen, comprehend, and take appropriate actions.
C4 Access, organize, and evaluate information.
C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

EXPANDED TOPICS FOR COMMUNICATIONS

TOPIC C1: Interpret written material.

C1.01 Read and follow complex written directions.
C1.02 Recognize common words and meanings associated with a variety of occupations.
C1.03 Adjust reading strategy to purpose and type of reading.
C1.04 Use sections of books and reference sources to obtain information.
C1.05 Compare information from multiple sources and check validity.
C1.06 Interpret items and abbreviations used in multiple forms.
C1.07 Interpret short notes, memos, and letters.
C1.08 Comprehend technical words and concepts.
C1.09 Use various reading techniques depending on purpose for reading.
C1.10 Find, read, understand, and use information from printed matter or electronic sources.

TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

C2.01 Use visuals in written and in oral presentations.
C2.02 Recognize visual cues to meaning (layout, typography, etc.).
C2.03 Interpret and apply information using visual materials.

TOPIC C3: Listen, comprehend, and take appropriate action.

C3.01 Identify and evaluate orally-presented messages according to purpose.
C3.02 Recognize barriers to effective listening.
C3.03 Recognize how voice inflection changes meaning.
C3.04 Identify speaker signals requiring a response and respond accordingly.
C3.05 Listen attentively and take accurate notes.
C3.06 Use telephone to receive information.

C3.07 Analyze and distinguish information from formal and informal oral presentations.

TOPIC C4: Access, organize, and evaluate information.

C4.01 Distinguish fact from opinion.
C4.02 Use various print and non-print sources for specialized information.
C4.03 Interpret and distinguish between literal and figurative meaning.
C4.04 Interpret written or oral communication in relation to context and writer's point of view.
C4.05 Use relevant sources to gather information for written or oral communication.

TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.

C5.01 Select appropriate words for communication needs.
C5.02 Use reading, writing, listening, and speaking skills to solve problems.
C5.03 Compose inquiries and requests.
C5.04 Write persuasive letters and memos.
C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
C5.08 Select and use appropriate formats for presenting reports.
C5.09 Convey information to audiences in writing.
C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.

TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.

C6.01 Give complex oral instructions.
C6.02 Describe a business or industrial process/mechanism.
C6.03 Participate effectively in group discussions and decision making.
C6.04 Produce effective oral messages utilizing different media.
C6.05 Explore ideas orally with partners.
C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
C6.08 Gather and provide information utilizing different media.

C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

RELATED ACADEMIC TOPICS FOR MATHEMATICS

M1 Relate number relationships, number systems, and number theory.
M2 Explore patterns and functions.
M3 Explore algebraic concepts and processes.
M4 Explore the concepts of measurement.
M5 Explore the geometry of one-, two-, and three-dimensions.
M6 Explore concepts of statistics and probability in real world situations.
M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
M1.04 Investigate relationships among fractions, decimals, and percents.
M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
M1.08 Use computation, estimation, and proportions to solve problems.
M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

M2.01 Describe, extend, analyze, and create a wide variety of patterns.
M2.02 Describe and represent relationships with tables, graphs, and rules.
M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
M2.04 Use patterns and functions to represent and solve problems.
M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.

M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.
M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.

TOPIC M4: Explore the concepts of measurement.

M4.01 Estimate, make,and use measurements to describe and compare phenomena.
M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.

TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.

M5.01 Identify, describe, compare, and classify geometric figures.
M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
M5.03 Explore transformations of geometric figures.
M5.04 Understand and apply geometric properties and relationships.
M5.05 Classify figures in terms of congruence and similarity and apply these relationships.

TOPIC M6: Explore the concepts of statistics and probability in real world situations.

M6.01 Systematically collect, organize, and describe data.
M6.02 Construct, read, and interpret tables, charts, and graphs.
M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
M6.04 Make predictions that are based on exponential or theoretical probabilities.

M6.05 Develop an appreciation for the pervasive use of probability in the real world.

TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

M7.01 Use computers and/or calculators to process information for all mathematical situations.
M7.02 Use problem-solving approaches to investigate and understand mathematical content.
M7.03 Formulate problems from situations within and outside mathematics.
M7.04 Generalize solutions and strategies to new problem situations.

RELATED ACADEMIC TOPICS FOR SCIENCE

S1 Explain the Anatomy and Physiology of the human body.
S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
S3 Relate the nine major phyla of the kingdom anomaly according to morphology, anatomy, and physiology.
S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

S1.01 Recognize common terminology and meanings.
S1.02 Explore the relationship of the cell to more complex systems within the body.

S1.03 Summarize the functional anatomy of all the major body systems.
S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
S1.05 Compare and contrast disease transmission and treatment within each organ system.
S1.06 Explore the usage of medical technology as related to human organs and organ systems.
S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
S2.02 Explain sexual and asexual reproduction.
S2.03 Describe the ecological importance of plants as related to the environment.
S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom anomaly according to morphology, anatomy, and physiology.

S3.01 Explain the morphology, anatomy, and physiology of animals.
S3.02 Describe the characteristics, behaviors, and habitats of selected animals.

TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.

S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.
S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.
S4.03 Consider the effects of weather and climate on the environment.
S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.

TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.

S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.

S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.
S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.
S5.04 Relate the behavior of gases.
S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.

TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.
S6.02 Explore the concepts and relationships among work, power, and energy.
S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.
S6.04 Identify principles of modern physics related to nuclear physics.

TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.

S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
S7.02 Apply the concept of population genetics to both microbial and multicellular organism.
S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.
S8.02 Observe and practice safe procedures in the classroom and laboratory.
S8.03 Demonstrate proper use and care for scientific equipment.
S8.04 Investigate science careers, and advances in technology.
S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

APPENDIX B:

WORKPLACE SKILLS

APPENDIX B
WORKPLACE SKILLS FOR THE 21ST CENTURY

WP1 Allocates resources (time, money, materials and facilities, and human resources).

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.

WP5 Selects, applies, and maintains/troubleshoots technology.

WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.

APPENDIX C:

STUDENT COMPETENCY PROFILE

STUDENT COMPETENCY PROFILE FOR ELECTRICIAN I

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation

_____ 1. Describe local program and vocational center policies and procedures.
_____ 2. Describe employment opportunities and responsibilities for electricians and related employees.

Unit 2: Safety

_____ 1. Describe personal and general safety rules for working in a shop/lab and industry.
_____ 2. Describe basic electrical safety practices.

Unit 3: Leadership and Personal Development

_____ 1. State procedures of leadership used to reach an agreement in an orderly manner and personal development opportunities provided students in electricity trades by the Vocational Industrial Clubs of America (VICA).
_____ 2. Identify desirable personal behavior and characteristics for use in the electrical occupations.
_____ 3. Identify legal requirement for participation in electrical occupations.

Unit 4: Direct Current (DC) Circuits

_____ 1. Describe the terms and scientific principles associated with direct current electricity.
_____ 2. Create circuits and measure DC electricity using the multimeter.
_____ 3. Describe the principles of magnetism and electromagnetic properties.

Unit 5: Alternating Current (AC) Circuits

_____ 1. Describe the terms and scientific principles associated with alternating current electricity.

_____ 2. Display and measure AC waveforms using the oscilloscope and function generator.

_____ 3. Describe and construct series and parallel circuits.

STUDENT COMPETENCY PROFILE FOR ELECTRICIAN II

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation

_____ 1. Describe local program and vocational center policies and procedures.
_____ 2. Describe employment opportunities and responsibilities for electricians and related employees.

Unit 2: Safety (Review)

_____ 1. Describe personal and general safety rules for working in a shop/lab and industry.
_____ 2. Describe basic electrical safety practices.

Unit 3: Advanced Leadership

_____ 1. Develop advanced leadership and organizational skills.

Unit 4: Tools, Equipment, and Materials/Supplies

_____ 1. Identify common tools, equipment, materials, and hardware used in electrical trades.
_____ 2. Identify conduit and wire cable working tools.
_____ 3. Bend, cut, ream, and thread conduit and install connectors on PVC.

Unit 5: AC Circuits for Residential Wiring

_____ 1. Determine the type and size of conductors/cables used in the electrical trades.
_____ 2. Determine wiring connections utilizing switching circuits to NEC and local codes.
_____ 3. Determine the grounding requirements according to NEC and local codes.

Unit 6: Blueprints and Calculations

_____ 1. Identify symbols and information commonly used on blueprints used in residential electrical trades.
_____ 2. Calculate circuit loads and voltage drops according to the wiring schematic to include carriers, load, and devices.
_____ 3. State minimum requirements for residential outlets according to NEC.

Unit 7: Load Centers and Overcurrent Protection

_____ 1. Determine the types of overcurrent protection devices, including fuses, circuit breakers, and ground fault circuit interrupts (GFCI) used in safety switches or load centers.

Unit 8: Rough-In

_____ 1. Determine locations of electrical outlets as shown on the electrical blueprint, according to the NEC.
_____ 2. Wire electrical devices/loads in accordance with NEC and electrical floor plan.

Unit 9: Residential Service

_____ 1. Determine service entrance requirements.

Unit 10: Trim-Out and Troubleshooting

_____ 1. Determine the requirements for electrical trim-out and troubleshoot a residence according to NEC.

Unit 11: Motors and Controllers

_____ 1. Demonstrate safe procedures associated with electrical motors in new and existing systems.
_____ 2. Differentiate between types/classes of electrical motors.
_____ 3. Determine speed, direction, and control of AC single- and three-phase and DC motors.
_____ 4. Identify the physical and electrical characteristics of electrical motors.
_____ 5. Identify the physical and electrical characteristics of electrical starters.
_____ 6. Wire single/three-phase electrical motors using manual and automatic controllers/starters with forward/reverse modes.

Unit 12: Programmable Logic Controllers (PLC)

_____ 1. Describe function and application of programmable logic controls.

Unit 13: Employability Skills

_____ 1. Develop employability skills.

END

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